SUBCUTANEOUS RUPTURE OF THE KIDNEY.

WITH A REPORT OF NINE CASES.

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The series published below is chiefly interesting from the different grades of kidney injury represented and the variety and character of complications present. The cases described were all observed at the Hudson Street Hospital within a period of three years. I am permitted to publish them through the courtesy of Dr. P. R. Bolton, in whose service they occurred.

Since the early contributions of Rayer (1839-41),[1] Bloch (1873),[2] Ravel (1873),[3] Simon (1876),[4] and the valuable work of Maas (1878),[5] so many complete and accessible papers have been published upon this subject by French and German writers, that there is little excuse for entering it at the present length, beyond the extreme practical interest which these cases always possess and the opportunities they afford for clinical and pathological study.

From the fact that a large number of the milder cases occurring from time to time in hospital and private practice have remained unreported, owing to their comparative unimportance, it is possible that the injury is much more frequent than may have been generally supposed. Delbét,[6] from all sources, has collected 320 cases.

Under the term rupture are included all degrees of injury, from mere contusion of the kidney substance without rupture of the capsule proper to the extreme degrees of laceration and pulpification of the organ. There are also included rupture of the blood-vessels of the pedicle and rupture of the pelvis of the kidney. Rupture of the ureter in close proximity to the kidney takes on characters that justify its consideration in company with injury to the kidney itself.

Etiology.—The cause of the injury is usually some form of violence directly applied to the abdomen, flank, or back, as a crush, a blow, or a fall from a height, the subject landing against some projecting object. Or the injury may be the result of indirect violence due to the force of the fall alone. Forced flexion of the body by which the organ is squeezed between the lower ribs and the vertebral column may also be a factor. Muscular contraction has also been assigned as a cause in a number of reported cases. E. Küster[7] has devised some interesting experiments in demonstration of the relative parts which two forces—pressure of the lower ribs in the direction of the vertebral bodies, and the hydraulic pressure of the contained fluid in the body and pelvis of the kidney—exert in the production of these injuries.

As a predisposing cause might be mentioned disease or abnormal conditions, making the organ, either from changes in size or structure, more susceptible to traumatic disturbance. Such a condition is represented in Case IX, where a lack of resistance due to a hydronephrosis accompanied by a chronic pyelonephritis permitted extensive hæmorrhage upon violence of probably less degree than is usually required for such an outcome. The part which mere enlargement of the organ in itself plays in rendering it more subject to all forms of violence is evident.

Pathology.—The pathology of these injuries has been studied in detail by Maas,[5] Edler,[8] Tuffier,[9] Grawitz,[10] Herzog,[11] and F. A. Rein,[12] from the results of operations, autopsies, and experiments upon animals. From their observations, the following facts are worthy of note.

Rupture may take place in the substance of the kidney without involving the capsule; or, as is often the case, may include both capsule and kidney substance. The rupture may involve the larger blood-vessels, the pelvis of the kidney, or the ureter.

The separation of the organ, owing to its structural development, is usually in a transverse direction, though frequently lacerations may be vertical, oblique, stellate, or irregular; or, the organ may be broken into a number of large or small fragments. Further, the organ may be completely crushed or pulpified; or, it may be torn loose from its pedicle and found lying free in the retroperitoneal tissues. Where the capsule is uninjured, the tendency is towards early cessation of hæmorrhage from pressure of the circumscribed clot. Where the capsule is torn, escape of blood is permitted into the loose, subjacent tissues, and if laceration is great, hæmorrhage may be extensive. Where, in addition, the peritoneum is torn, allowing free entrance of blood into the peritoneal cavity, the tendency is towards uninterrupted hæmorrhage.

Laceration of the peritoneum occurs most frequently in children under ten years of age, owing to the non-development of the subperitoneal fat and the close attachment of the peritoneum before this period.

Infection of extravasated products may result in septic peritonitis, in diffuse infection in the kidney, or in abscess formation, either within or adjacent to the injured organ. The avenues of infection are the ureters, the blood and lymphatic vessels; the former two are the usual channels of infection. Where infection occurs by way of the ureter, its source may be a urethritis or a cystitis existent before injury, or may be a more recent septic process kindled through extraneous infection of decomposed blood-clots accumulated in the bladder. The uninjured kidney of the opposite side may also become the seat of disease through a progressive infection of this character.

Where infection occurs by way of the blood, the point of origin may lie in some such distant focus as has been demonstrated to exist in those cases of infection occurring in the course of non-traumatic affections of the kidney; such as a furuncle, a carbuncle, a felon, or an osteomyelitic abscess.

Opposed to the theory of a hæmatogenous infection of an injured kidney are the results of Rinne's experiments cited by Grawitz[10] and Herzog.[11] This observer introduced foreign substances repeatedly into the kidney substance of animals under aseptic precautions, and was unable to secure infection of the involved tissues after introduction of pure cultures of pus-producing cocci into both the blood and peritoneal cavity. That such infection does occur, however, is well illustrated by a case from Israel,[13] which is briefly as follows:

> The patient, after exhibiting typical symptoms of subcutaneous rupture of the kidney with the early development of a palpable tumor mass in the loin and the subsequent advent of septic symptoms, was operated upon on the eleventh day. Incision down to the infected kidney disclosed two abscesses, located behind the hilum and behind the body of the kidney respectively. Cultures from the abscess contents and from the urine, both before and for several days after operation, gave pure cultures of the Bacillus coli communis. There had been an obstinate constipation for six days preceding the development of the infection.

In connection with this case Israel mentions the well-known experiments of Posner, who produced occlusion of the intestines in animals by artificial means, and subsequently demonstrated at the termination of the process a wide-spread invasion of the whole organism by the Bacillus coli communis. The kidneys especially were found to be the seat of bacterial invasion.

Abscess formation is more frequent in the substance of the kidney than in the adjacent tissues. It may have the form of a single abscess cavity or consist of multiple foci. When the abscess has its origin in the perirenal tissues, it may point in the lumbar or inguinal region, or it may perforate into the pelvis of the kidney or the ureter, or into the intestine or the pleural cavity.

Where the pelvis of the kidney is torn, there may be extensive extravasation of urine into the adjacent tissues with the formation, in the absence of infection, of a large retroperitoneal cyst. Such a collection may attain enormous size, as was observed in Case VIII. This condition, sometimes termed a hydronephrosis, but better a pseudohydronephrosis from the fact that it lies outside the pelvis of the kidney, occurred nineteen times in the table brought together by Delbét.

Symptoms and Signs.—The most constant and characteristic symptoms are pain and hæmaturia. The local pain is always present unless obscured by shock or coma. Occasionally there are present ureteral pains of a colicky character from the passage of clots towards the bladder; or painful micturition may occur from the same cause. The collection of clots in quantity in the bladder, it may be noted here, is infrequent. It occurred only three times in Maas' seventy-one cases. Hæmaturia, while a fairly constant symptom, may be intermittent in character; or it may be late in making its appearance, from several days to two weeks, in reported cases; or it may be altogether absent in rare cases. These variations are usually due to obstruction to the outflow of urine into the ureter by clots, though thrombosis of the renal vessels and tearing of the ureter are also occasional causes, and stricture of the ureter has accounted for the absence of hæmaturia in one instance.[14]

Oliguria is often met with. Anuria occasionally occurs. It is usually due to shock, and secretion is resumed in from twenty-four to forty-eight hours. Where the kidney of the opposite side is absent, injured, or diseased, the condition may persist to a fatal termination. Besides blood, the urine may present casts and large quantities of epithelial débris; and later, if suppuration occurs, pus-cells are found.

Shock is always present in greater or less intensity, and, unless associated with coexisting injuries to other structures, is often a valuable index of the extent of hæmorrhage present.

A temperature varying usually from 100° to 101° F. is very often present during the first three or four days, and considerably higher temperatures are sometimes exhibited without further cause than local tissue reaction.

The presence of a tumor mass is usually recognized with difficulty in the early stages of injury, but the rigidity of the muscles of the back and flank is an early and characteristic sign. Where hæmorrhage takes place into the peritoneal cavity characteristic signs are often evinced on palpation and percussion. Later, the symptoms of a general peritonitis may be present.

If suppuration occurs in or around the kidney, rigors, temperature, sweating, and, later, exhaustion make themselves evident.

Complications.—For convenience of study, we may divide complications as they are found in this class of injuries into the following heads: They may be due (*a*) to pre-existing abnormal conditions, such as congenital malformations, nephritis, or hydronephrosis; or (*b*) to conditions brought about by changes occurring at the site of injury or in closely related structures, such as extracapsular hæmorrhage, either into or behind the peritoneum, secondary nephritis, and the septic processes; peritonitis, when it occurs as a result of the kidney injury, abscess formation, cystitis, and secondary infection of the opposite kidney; or (*c*) to traumatic lesions of other organs or structures induced at the time of injury, such as rupture of the spleen, liver, and intestines, or fractures and luxations of the bones, or injuries to the brain and cord; or (*d*) to intercurrent affections such as pneumonia, pleurisy, and pericarditis. An example of complication under the first head occurs in Case IX, under the second in Cases IV and VIII, under the third in Cases V, VI, and VII, and under the fourth in Case III.

Diagnosis.—The diagnosis is usually easy and is based on the history of the injury, together with the symptoms of local pain and hæmaturia and the rigidity of the muscles of the back and flank. It is only in the cases where hæmaturia is absent or late in making its appearance, and in those cases complicated with injuries to other viscera, that difficulty in diagnosis presents itself; and in the latter case the difficulty is not as much one of determining the fact of kidney injury, as it is the extent of this injury, and the relative part it plays in the complex of symptoms present. This is often practically impossible without recourse to exploratory incision, as was done in Cases IV and V.

The early employment of the catheter often expedites the diagnosis of a suspected kidney injury.

The diagnosis of extensive hæmorrhage is evident from the well-known train of symptoms incident to internal hæmorrhage; persistent or rapidly increasing shock, thirst, restlessness, and the rapid development of secondary anæmia. It may be still further confirmed by the discovery of a palpable tumor mass in the flank or abdomen.

The diagnosis of septic processes in the peritoneal cavity or within or adjacent to the kidney is usually made sufficiently plain by the train of symptoms belonging to these respective conditions. Bacteriological examinations of the blood and urine may also serve to throw light on a suspected case of infection in the kidney or adjacent tissues.

Course.—In uncomplicated cases the course is usually a mild one. Succeeding the initial shock, after from three to five days of local pain of greater or less intensity, perhaps a slight temperature, and a period of hæmaturia of from two to ten days longer, convalescence is established. The whole duration in ordinary cases is given as anywhere from two to four weeks. Two or three weeks probably represent the average. Occasionally pain persists for a considerable period after all other symptoms have subsided. Edler [8] mentions an otherwise simple case where pain was present as the only remaining symptom for a year after the disappearance of all other symptoms. In a similar way hæmaturia alone or accompanied by pain has been known to persist from six weeks to several months after injury. Typical cases of simple rupture of the kidney treated on the expectant plan are Nos. I and II.

In complicated cases the course varies with the identity of the structures involved and the character and intensity of the lesions. Grawitz [10] gives the causes of fatal termination in the following order: (1) Primary hæmorrhage, (2) Secondary or prolonged hæmorrhage, (3) Septic processes, (4) Suppression of urine from injury, disease, or non-development of the other kidney.

When rupture of the capsule proper of the kidney occurs and the hæmorrhage is confined to the retroperitoneal tissues, the danger of a fatal termination is much less than when a rent through the peritoneum allows free escape of blood into the peritoneal cavity. When in addition to the kidney other intra-abdominal organs, such as the spleen, the liver, and the mesentery, are torn, enormous and rapidly fatal hæmorrhage often takes place, as occurred in Cases VI and VII.

If the danger of hæmorrhage is safely passed, the advent of sepsis, either early or remote, is to be reckoned with. As stated, sepsis may occur as a rapidly fatal peritonitis, an abscess within or adjacent to the kidney, a diffuse infection of the kidney, or a progressive infection of the urinary tract beginning in the urethra or bladder.

The occurrence of a traumatic nephritis of a non-septic character as a sequel to rupture of the kidney is rare.

In the absence of infection, extravasated products tend either to resorption or, as in the case of rupture of the pelvis or the kidney or ureter, to cyst formation. Rupture of the pelvis of the kidney from pressure of surrounding extravasated products and their spontaneous discharge through the ureter is a termination that has been observed and reported a number of times.[15]

Prognosis.—In the simple cases, accompanied by slight or moderate degrees of hæmaturia and in the absence of evidences of extended extracapsular hæmorrhage, the prognosis is very good, practically complete recovery taking place, usually within a period of from two to three weeks.

In cases with marked extracapsular hæmorrhage, either within or without the peritoneal cavity, the prognosis in the absence of early operation is very grave, death occurring primarily from hæmorrhage, secondarily from septic processes.

In cases complicated with rupture of one or more of the intra-abdominal organs with evidence of profuse internal hæmorrhage, the prognosis is serious in cases adapted to operation; practically hopeless in those left without operative intervention.

Treatment.—The treatment is non-operative and operative.

1. *Non-operative Treatment.*—In simple cases with evidences of only slight or moderate hæmorrhage the treatment is expectant. The patient is placed at absolute rest in bed, with milk diet. Ice-bags are applied over the injured loin and abdomen and morphia administered where required for the relief of pain and restlessness. The use of internal remedies for the control of hæmorrhage, such as ergot, gallic acid, and lead acetate, may also be tried. Where the employment of the catheter is necessary, either for the relief of retention due to clots or for diagnostic purposes, the strictest antiseptic precautions should be observed. Where there is extensive accumulation of clots in the bladder, their removal by means of a suitable evacuator is indicated.

2. *Operative Treatment.*—This has two main objects in view,—the control of hæmorrhage and the prevention of subsequent septic processes at the site of injury. The cases complicated by profuse extracapsular hæmorrhage, either within or external to the peritoneal cavity, and those complicated with injury to other intra-abdominal structures require prompt operative interference.

The conditions that demand exploratory incision after the lapse of the first forty-eight hours are evidences of continued hæmorrhage, persistent anuria, septic symptoms, and a well-defined tumor-mass independent either of evidences of marked hæmorrhage or of a septic process. In the latter case, if no other condition is found present at operation than a mass of extravasated blood and urine, incision is justified, since the removal of such material means the prevention of a possible septic process later.

The incision that practical experience has proven best adapted to all cases of traumatic kidney lesion of the class under consideration is the transverse incision of McBurney, which begins at the outer border of the erector-spinæ muscle and passes forward just below the free border of the ribs to end at about the anterior axillary line. Its advantage is that it gives free access at will to both intra- and retroperitoneal spaces, affords satisfactory inspection of all the intra-abdominal organs when necessary, and can be extended forward so as to give ample room for any manipulative procedures required in dealing with the kidney and its vessels, the spleen, or adjacent structures.

The methods of dealing with the torn kidney in operation for the relief of hæmorrhage consist in suture, packing, and partial or total removal of the organ. Suture is indicated in cases with slight or moderate laceration where the organ is accessible for such manipulation. It may be used alone or supplemented by packing. Packing is indicated in cases of the same character when they are not accessible to suture. Alone or accompanied by suture, it is also indicated in the severer cases where there is extensive laceration, but where disorganization of the kidney has not taken place. It is further used in cases of partial nephrectomy and in those cases of most severe character where, though laceration and disorganization of the kidney is extreme, total extirpation is impracticable, owing to inaccessibility of the organ.

Partial nephrectomy is indicated, first, in those cases where one extremity or pole of the kidney is torn away, but its pelvis is uninjured and its main blood supply intact; secondly, in the cases of extreme laceration just described, where, from inaccessibility of the organ, simple packing, or packing with removal of detached or accessible portions of the organ, must take the place of complete nephrectomy.

Complete nephrectomy is indicated, first, in those cases of extreme laceration and pulpification of the kidney or laceration of its blood-vessels where there is no possibility of its further usefulness; secondly, in cases of more moderate degree, but where hæmorrhage being profuse, shock great, and the organ easily accessible, its removal affords the promptest and most efficient means of hæmostasis.

A further great advantage in primary nephrectomy in cases where a choice might lie between it and apparently more conservative measures is its removal of the possibility of subsequent septic processes in the kidney and the establishment of obstinate urinary fistulæ.

Contraindications for nephrectomy are injury, disease, absence, or congenital malformation of the opposite organ.

Whatever special form of operative treatment is employed in meeting the conditions described, the provision for drainage in every case must be adequate and thorough.

The treatment of so-called traumatic hydronephrosis following injury to the kidney consists in aspiration of the sac, incision, with repair of the injury to the pelvis of the kidney, and nephrectomy. Aspiration is the first measure to be tried, and is to be repeated one or more times, supplemented, perhaps, with injections of iodine. If these measures are not successful, exploratory lumbar incision is to be made, the wound in the pelvis of the kidney repaired, and the sac obliterated and drained. If repair to the pelvis of the kidney prove impracticable, the organ is to be removed either by primary operation, if the sac is small and adhesions not extensive, or by secondary operation after drainage of the sac if it be large or adhesions extensive.

CASE I. *Simple Rupture of Kidney; Conservative Treatment; Recovery.*—Male, aged twenty-nine years; cable-car conductor; on September 22, 1899, was caught and squeezed between two cars, and was removed a short time after the accident to the Hudson Street Hospital. Examination showed a moderate degree of shock, fracture of the ninth and tenth ribs in the left posterior axillary line, and contusion and tenderness over the left lower dorsal and lumbar regions. He complained of great pain in this locality, and a specimen of urine passed a half-hour after admission was dark and smoky and contained a large number of red blood-cells. Examination at this time showed slight rigidity and tenderness of the left half of the abdomen. For several days this condition persisted, and blood was present in the urine in decreasing amounts up to the sixth day. No other symptoms, however, presented themselves, and the patient rapidly improved up to the time of his discharge on the eleventh day.

CASE II. *Simple Rupture of the Kidney; Conservative Treatment; Recovery.*—Male, aged twenty-nine years; driver; on August 16, 1899, was run over by a truck, the wheel passing across his body from left to right. On admission to the hospital a half-hour later he was suffering a moderate degree of shock and complaining of severe pain in the left flank. Examination showed slight contusion over this locality with some tenderness. The abdomen showed great tenderness over the left lumbar region, and an imperfectly defined area of dulness extending upward and forward from the flank to the anterior axillary line. Temperature was 98.2° F.; respiration, 18; pulse, 92, regular, soft, and fairly full. The first specimen of urine passed two hours after his being placed in the ward was dark red in color, smoky, and contained large numbers of red blood-cells. An ice-bag was applied to the loin, and the patient passed a fairly good night. On the following morning the urine was amber in color and showed very few red blood-cells. On the third day he still complained of pain in the back and flank, but his urine was clear and his general condition good. On the fourth day the general condition was much the same, temperature ranging about 100° F., and pulse of good quality, but examination of the urine showed diffused blood in considerable quantity. On the fifth day the urine was of about the same appearance, but patient was much more comfortable than he had yet been, and his general condition was excellent. On the sixth and seventh days blood in urine was diminishing and patient rapidly improving. On the eighth day he sat up. The urine at this time was practically amber in color, but still showed microscopically a small number of red blood-cells. He was discharged cured on the ninth day.

CASE III. *Rupture of the Kidney complicated with Pleuritis; Conservative Treatment; Recovery.*—Male, aged thirty-nine years; stenographer; on September 20, 1899, was caught between a moving "L" car and the platform rail; while still retaining his feet, he was squeezed through the chest and upper part of the abdomen and rolled and dragged along a distance of several feet. When brought to the hospital shortly afterwards, he showed a slight amount of shock, and complained of pain generally distributed through the lumbar region. He presented a scalp wound, and there was considerable tenderness and contusion over the dorsal and lumbar areas. He was placed in bed, and an hour or so later passed a quantity of smoky urine which disclosed large numbers of red blood-cells on microscopic examination. The night was passed in some pain, relieved in greater part by morphia.

During the following day a slight temperature began to develop, and the urine passed contained considerable quantities of diffused blood. The evening temperature was 101° F.; pulse, 104; respiration, 38. The patient seemed uneasy and restless, and complained of indefinite pain over the right half of the back in the lower dorsal and lumbar regions. He was pale, but there were no evidences of pronounced shock, and his general condition seemed fair. With the possibility in view that these symptoms might be associated with hæmorrhage or intraperitoneal complication, a careful examination was made at this time. Except for slight rigidity and distention, the abdomen was negative. Examination of the right chest posteriorly showed noticeable diminution in respiratory movement over its lower portion, and on auscultation respiratory sounds were found much diminished. On the following morning well marked localized pain on inspiration and the appearance of friction sounds confirmed the presence of a dry pleurisy. Slight temperature and rise of pulse rate continued for several days, and blood was present in the urine in decreasing quantities up to the seventh day. The patient was discharged cured on the eleventh day.

Case IV. *Rupture of the Kidney with Extensive Extracapsular Hæmorrhage; Nephrectomy; Recovery.*—Male, aged ten years; school-boy; on July 11, 1899, while riding on the inside seat of an open trolley-car, was struck in the left side of the abdomen by the protruding pole of a wagon. He walked to the hospital, a distance of several blocks. When seen in the out-patient department, some twenty minutes after the accident, he was pale, covered with a profuse sweat, and was very restless, but complained of no pain, and there was no evidence of external injury. The boy wished to go home, declaring that he was all right; and it was only after some persuasion that his friends permitted him to remain in the hospital. He was sent to the wards and put to bed. Pulse was 104, respiration, 36; temperature, 99° F. Strychnine sulphate, one-thirtieth of a grain every three hours, was ordered, and, as restlessness was great, a hypodermic of morphia was given. Four hours after injury he complained of sharp pain in the left lumbar region, and two hours later, after painful micturition, passed a few ounces of blood-streaked, smoky urine. During the night and during the early forenoon of the following day the pulse gradually became weaker and more frequent, and the patient was accordingly prepared for operation. The urine now passed was clear and free from blood, but the pulse had risen to 116, respiration 36, temperature 101° F. The abdomen was slightly distended and not tender, but there was rigidity of the muscles over the left side of the abdomen, and a poorly-defined area of dulness could be perceived in the left lumbar region of the abdomen.

Operation.—At noon, twenty hours after injury, the pulse was 136, very soft and of poor quality; respiration was 44, temperature 101.2° F. Nitrous oxide and ether anæsthesia was begun at this time; and as the mode of injury, the rapid increment of shock, and the early development of rigidity and dulness in the left side of the abdomen pointed to the spleen as the possible source of greatest hæmorrhage, a small incision was made through the outer border of the left rectus muscle over the splenic area and the abdomen explored. The spleen was found intact, though a few small blood-clots were found scattered free among the neighboring intestines. Posteriorly a large hæmatoma could be distinguished lying behind the peritoneum in the left lumbar region, so the incision was rapidly closed and the patient turned upon his side. The König incision was then made over the left lumbar region, and on piercing the lumbar fascia a mass of fluid and clotted blood welled into the wound. This bloody fluid, amounting in all to about three pints, was quickly sponged away, a large clamp applied to the pedicle, the ureter and vessels in turn tied off, and the organ cut away. At this juncture the pulse was 156 and very thready, and signs of collapse became so urgent that the wound was packed without suture, while intravenous infusion of salt solution was being proceeded with. At the conclusion of the dressings, with free rectal and hypodermic stimulation, the pulse had dropped to 140. Patient rallied quickly from his shock, and at midnight the pulse was down to 124, and he was resting quietly. He made a rapid and uneventful recovery, the incision closing on the twentieth day.

Specimen.—Examination of the excised organ showed a cruciform rent centring on the anterior surface of the organ near the middle of the outer border. Transversely from this point the substance of the kidney was torn through on each side clear into the hilum. Vertically, a tear extended upward to within an inch of the upper extremity of the organ, while in the opposite direction the tear extended from the central point entirely through the substance of the lower extremity.

CASE V. *Rupture of the Kidney complicated with Rupture of the Spleen; Splenectomy; Recovery.* — Male, aged twelve years; Italian; on the evening of August 21, 1899, fell, and was stepped on by a horse while lying upon the ground on his back, and was brought to the hospital a few minutes later. On admission the boy was in a slight degree of shock and complained of pain in the left lumbar region and flank. He was pale, pulse 92, regular, full, and soft. The abdomen was practically normal in appearance, but there was rigidity and extreme tenderness over the painful region of the back and side. A specimen of urine drawn by catheter for diagnostic purposes was of deep smoky appearance and contained large numbers of red blood-cells. During the night the patient slept quite a little, but awakened at intervals and complained of pain in the back and loin. The pulse ranged between 100 and 116, was regular but not full, and rather too soft. When seen at midnight the abdomen was slightly distended, slight tympanites and rigidity were present, and well-marked rigidity existed over the lumbar region. The tenderness and pain seemed to be more generalized over the abdomen. Flatness was present over the left flank. During the next day the appearance of the abdomen remained about the same, but the general condition of the patient became noticeably worse. By evening he was very weak, restless, and in great pain, and incision was decided upon. Pulse at this time was 104, regular, soft, and somewhat weak; respiration 20.

Operation.—Twenty-four hours after injury, under nitrous oxide and ether, a vertical incision was made through the outer border of the left rectus muscle a little below the free border of the ribs, and on opening the peritoneum a few loose blood-clots and some free blood were encountered. On further inspection the spleen was found ruptured, its lower one inch being practically torn away. A clamp was applied to the torn surface and the abdominal cavity washed free of blood-clots with saline solution. While this was being done, a fair sized hæmatoma could be observed lying behind the intact peritoneum over the region of the left kidney. After the cleansing of the abdominal cavity was completed, the pedicle of the spleen was tied with catgut, the organ removed, and the wound closed with a single small gauze drain passing to the site of the stump. A good recovery was made from the operation, and on the following day the patient presented a much improved pulse and a promising general condition. The urine was smoky, dark, acid; specific gravity 1026, with a trace of albumen, epithelium, and large numbers of red blood-cells. On the third day the urine was clear, with a trace of albumen and a diminished number of red blood-cells. On the fourth day the urine showed very few red blood-cells and the patient was steadily improving. By the ninth day, when the sutures were removed from the abdominal wound, the urine was found clear and free from red blood-cells, but $^1/_{10}$ per cent. of albumen by volume was present. Beyond some sleeplessness and other general nervous manifestations and the presence of a slight trace of albumen in the urine, the patient showed no further abnormal symptoms up to the time of his discharge on the twenty-fifth day. He has been seen at the hospital many times subsequently, and is apparently enjoying the best of health.

CASE VI. *Rupture of the Kidney complicated with Rupture of the Spleen; Splenectomy; Death from Primary Hæmorrhage and Shock.*—Male, aged thirty-two years; Italian; street cleaner; on October 15, 1901, at about midday, was knocked down and fell under the front wheel of a truck, which pushed him along for several feet and held him pinned to the pavement, but did not pass over his body. On admission he was conscious, suffering from considerable shock, and complaining of great pain in the left side of the abdomen and back. Temperature, 98° F.; pulse, 80; respiration, 28. He showed great general pallor, and some fulness appeared to be present over the left side of the abdomen. Palpation gave marked tenderness over the entire left side of the abdomen and over the lumbar region posteriorly, and the left half of the abdomen was markedly rigid. There was dulness in the left axillary line from the sixth rib to a distance of two inches below the free border of the ribs. Catheterization obtained a quantity of very bloody urine, and after the withdrawal of the catheter blood continued to be expelled from the urethra, a considerable amount being lost in this way. By night a marked degree of shock was present. Pallor was most intense. Pulse was only 92, but noticeably weaker than on admission. The temperature had risen to 100.2° F.

Operation.—Seven hours after injury, under nitrous oxide and ether, a long transverse incision was made through the left lumbar region just below the free border of the ribs. On opening the peritoneum, the abdominal cavity was found filled with blood, and a much enlarged spleen extensively lacerated and partially torn from its peritoneal attachments. Bleeding surfaces were secured as rapidly as possible by means of clamps, ligatures, and sutures, the pedicle of the spleen tied off, and the organ cut away. The abdominal cavity was then repeatedly washed with salt solution and an enormous quantity of blood washed away. No other points of intraperitoneal hæmorrhage were found, and it was evident that hæmorrhage must have been very free from the torn surfaces of the spleen and from the lacerated pedicle and attachments. A large hæmatoma lay in the retroperitoneal tissues over the left kidney; but in view of the great loss of blood that had evidently taken place into the abdomen and the condition of the patient, it was unadvisable to continue operative interference further. The patient left the operating room with a pulse of 160, in spite of infusion and free stimulation. During the following day there was progressive collapse, and death occurred thirty-six hours after admission.

No autopsy.

CASE VII. *Rupture of Kidney; Rupture of Mesenteric Vessels; Operation; Death from Primary Hæmorrhage.*—Male, aged twenty-three years; a driver; while at work on the afternoon of July 7, 1900, became caught between two trucks, which squeezed his body from before backward, his abdomen receiving the brunt of the contusion. He was brought to the hospital in a state of extreme collapse, pulse very rapid and shallow, air hunger marked. There was great paleness of the entire body. No abrasion or other injury was apparent upon the surface of the abdomen on inspection, but pressure showed great tenderness. Morphia was administered and free stimulation with strychnine and whiskey was begun. A specimen of urine obtained an hour and a half after injury contained a large quantity of diffused blood. As collapse continued, sixty-four ounces of salt solution were infused eight hours after injury, and hypodermic stimulation was made very free. Pulse at this time was 148 and quite weak. An hour and a quarter later, a saline enema of thirty-two ounces was given, and a half-hour later a second infusion of sixty-four ounces. Patient was sent to the operating room nine and a half hours after injury with a pulse of 148 and respiration 50. Under cocaine anæsthesia the abdomen was opened in the midline. On incising the peritoneum, there was an escape of considerable gas and some odor, and a large quantity of blood welled into the wound. The intestines were examined, thoroughly washed, together with the remainder of the abdominal contents, returned, and gauze drainage inserted. The incision was only partially closed, and the patient returned to the ward with a pulse of 124 and respiration 24. An hour later the pulse had risen to 180, and death occurred twelve and a half hours after injury.

Autopsy.—Showed a red, congested, and somewhat opaque peritoneum. The mesentery showed at one point near its attachment a laceration six centimetres in length. Mesentery, mesocolon, and the retroperitoneal tissue, especially that of the right side, were distended with effused blood. The right kidney was of normal size, pale, and flabby. Its anterior surface was marked by a number of lacerations varying in length from a third to a half centimetre. Both large and small intestines showed numerous small areas of submucosal hæmorrhage.

CASE VIII. *Rupture of Pelvis of Kidney; Formation of a Large Retroperitoneal Cyst (Pseudohydronephrosis); Nephrectomy; Recovery.*—Male, aged thirty years; printer; on the evening of April 28, 1900, was knocked down and run over by a truck, and was brought in the ambulance to the Hudson Street Hospital. On admission he gave no evidence of serious injury, and showed merely rather extensive contusion of the back in the left lumbar region. He complained, however, of great and continuous pain in this locality, and this persisted to some extent on the following day, when at his own request he was allowed to return to his home in Brooklyn. No other untoward symptoms were observed during his stay overnight in the hospital, though the urine was not examined. Two and a half months later the same patient was admitted to Dr. Bolton's care at Bellevue Hospital with the following interesting recital. After leaving the Hudson Street Hospital and returning home, he endured three or four days of continuous pain, and then sought relief at a Brooklyn hospital. Here he was put to bed for two weeks with an ice-coil upon his abdomen, and at the end of this time, the pain being somewhat relieved, was allowed to go home again. But after remaining at home for three days, the pain recurred with so much severity that he returned to the hospital. This time an incision was made in the left side of the abdomen, and he was told a clot of blood had been removed from the intestine. In three weeks he was up, and was about to go home, when a swelling was noticed in the left side of the abdomen. Thereupon a long needle was inserted below and to the left of the umbilicus, and four quarts of clear, yellowish-white fluid were withdrawn, and he was allowed to go home on the following day. Four days later he noticed that the swelling had reappeared, and in a week's time the abdomen was so distended, pain and difficulty in respiration so pronounced, that the patient applied to Bellevue Hospital for admission June 27, 1900. On admission, inspection of the abdomen showed an ovoid tumor, apparently eight or nine inches long, occupying the left side of the abdomen, with its long diameter vertical and its centre about four inches from the midline. The left side of the abdomen bulged markedly, the skin over the tumor was tense and shiny, and the cutaneous veins over the iliac region were noticeably distended. A bright red vertical scar five inches long extended from the lower border of the twelfth rib on the left side to the crest of the ilium at its posterior third. On palpation the tumor was found to fluctuate, and the abdominal wall was apparently movable over it. Percussion gave flatness over the whole left half of the abdomen, tympany over the right.

Operation.—On June 29, under ether anæsthesia, an incision seven inches long was made obliquely downward and forward from the edge of the erector-spinæ muscle into the left lumbar and iliac regions. On penetrating the lumbar parietes, there was a profuse gush of fluid from beneath. This fluid was evacuated and amounted approximately to two gallons. It was watery, red, opaque, and odorless. The sac was irrigated with hot salt solution, and a hand introduced within it found a cavity extending upward to the subphrenic region, downward into the iliac fossa, and inward to the vertebral column. On the anterior surface of the sac and close to the spinal column was discovered an oval, flattened body, which presented a depression on its inner border. This was thought to be the left kidney, and it appeared to be slightly enlarged. The sac was drained by rubber tubes and iodoform gauze packing and the wound closed. At the end of two months' time the site of the drainage tube had diminished to a small fistula, which continued to discharge clear urine; there had been no recurrence of the tumor. A second operation was then determined upon for the removal of the kidney.

Operation.—Accordingly, on August 31, four months after injury, the patient was again placed under ether and a transverse incision seven inches long made in the lumbar region. A probe that had been passed from the mouth of the fistula through the shrunken sac was found to enter the pelvis of the kidney. The organ, on being partially freed from its very firm adhesions to the anterior wall of the cystic sac, was found to be of normal appearance. It was attempted to so free the kidney as to expose and suture the opening in its pelvis, but, owing to the extent and firmness of adhesions, this was found impossible, so the organ was removed. A rent in the peritoneum where the kidney had been adherent was closed with catgut sutures, and the sac then obliterated by deep muscular sutures of chromic gut. Iodoform gauze drains were then inserted down to the pedicle stump and the incision closed. On the following day the drains were removed. By the seventh day the wound was closed and sutures were removed. The patient made a subsequent uninterrupted recovery. He has been seen a number of times since at the hospital and his health is apparently normal.

CASE IX. *Rupture of a Hydronephrotic Kidney; Nephrectomy; Recovery.*—Male, aged thirty-five years; a baker; applied for admission to the hospital, September 11, 1901, with the following history. Four days previous he had been violently struck with a club over the left hypochondrium. He felt severe pains following the injury, and went the same day to a well-known dispensary for treatment. It was found there that he had a fluctuating swelling in the left side of the abdomen, and that there was a large quantity of blood present in his urine. The character of his injury was diagnosed, and he was advised to go to a hospital for treatment, which he did only after remaining at home for three days and suffering greatly from pain, accompanied with hæmaturia and with no diminution in the size of the tumor. On admission he stated that he had always enjoyed good health, and that he had never to his knowledge suffered from any previous injury or disease bearing upon the genito-urinary tract, that he had no knowledge of the former existence of a tumor, and that, so far as he knew, his urine had never presented any abnormality in quantity or appearance. Examination showed a well developed, well nourished man. The chest showed a well marked anterior bulging at its lower portion on the left side and loss of fremitus, with flatness from the sixth rib down to the free border. The abdomen showed a well marked prominence continuous with that of the chest, extending from the left hypochondriac region downward and inward nearly to the umbilicus. The swelling gave on palpation the sensation of a large, elastic, slightly fluctuating tumor apparently extending upward beneath the free border of the ribs. The urine showed the admixture of so much blood that its appearance was almost that of pure blood itself. It was voided in nearly normal quantity. Admission temperature was 100.6° F.; respiration, 36; pulse, 88.

Operation.—On the following day, five days after injury, under nitrous oxide and ether anæsthesia, a transverse incision eight inches long was made just below the free border of the ribs, extending from the outer border of the erector-spinæ muscle anteriorly into the left hypochondriac region. On separating the lumbar fascia an enormously dilated cystic kidney was found. It was punctured with an aspirating needle and sixty-five ounces of bloody urine were withdrawn. The kidney was then separated from its peritoneal adhesions, its pedicle tied, and the organ removed. Iodoform gauze packing and suture completed the operation. Following operation, the temperature rose to 103° and 104° F., where it continued for thirty-six hours, and then fell to normal. The pulse during this period was 124 to 136. Patient made an uneventful recovery, except for an irregular temperature, together with urine of a low specific gravity and about 5 per cent. albumen by volume up to the fortieth day. On his discharge on the fiftieth day the operation sinus had closed; he was in good physical condition, and his urine showed a specific gravity of 1011, $^1/_{20}$ per cent. albumen by volume, and no casts.

Specimen.—Examination of the specimen removed at operation showed an enormously distended kidney, measuring twenty-two by fourteen by ten centimetres, with very thin walls, and divided into three loculi, two of which communicated directly with the pelvis. The pelvis was enlarged, but the obstructing cause was not present in the portion of the tract removed. No gross traumatic lesion could be found, but section of the cyst wall showed, in addition to a chronic pyelonephritis, many small but widespread areas of hæmorrhage into the submucosa.

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